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| Course title :**Plant Science IV** | Full marks : 50 (40T + 10P) |
| Course No. : Sc. Ed. 448 | Pass marks : 14T + 4P |
| Nature of the course : Theory & Practical  Level : B.Ed. (4 Year) | Periods per week : 3T  Practical ( 3P) : 3pds/2 weeks /gr. |
| Year : Fourth | Total Periods : 75 |

1. **Course Description**

This course consists of theory and practical sections. Students are required to secure pass marks independently both in Theory and Practical. The theoretical part aims to give some knowledge to the students on medicinal and aromatic plants of Nepal, organic and mushroom farming, seed science and technology, about the seed borne diseases and advanced knowledge on plant growth and development whereas practical part deals with identification and preservation of some important medicinal and aromatic plants, testing of seeds for sowing, preparation of culture media for fungi, culture and identification of some seed borne fungi, culturing techniques for some mushrooms and different aspects of developmental biology of plants regarding plant cell, tissues and organs.

**2. General Objectives**

The general objectives of this course are as follows:

* To acquaint the students with some important medicinal and aromatic plants (MAPs) of Nepal.
* To impart some theoretical and practical knowledge of organic and mushroom farming.
* To familiarize the students with some important aspects of seed science and seed technology.
* To acquaint the students with seed borne fungi and their culture technique.
* To acquaint the students with the growth and development of plant cell, tissues and organs.

**3.Specific Objectives and Contents**

**Part I: Theory**

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| **Specific Objectives** | **Contents** |
| * Define medicinal and aromatic plants (MAPs) with examples and impart knowledge on their present and future scope. * To explain the distribution of major MAPs in various climatic zones in Nepal. * Describe the measures for conservation of MAPs in-situ and ex-situ. * Explain the national policy and programs for promotion of MAPs in Nepal. * Describe the morphology, importance, climatic and soil requirements, cultivation and harvesting techniques of commercially important MAPs of Nepal. * Describe the uses and sustainable harvesting technologies of some important MAPs: * List some important herbs (mentioned in the content) used for cosmetics and explain their cosmetic uses. | **Unit I. Medicinal and Aromatic Plants(MAPs) (25)**   * 1. Introduction – Present status and future scope of MAPs   2. Distribution of major MAPs in various climatic zones in Nepal   3. Conservation of MAPs in-situ and ex-situ   4. National policies and programs for promotion of MAPs   5. Cultivation technology of some commercially important MAPs of Nepal:   *Swertia chirayata* (Chiraito), *Asparagus racemosus* (Kurilo), *Valeriana jatamansi* (Sugandhwal), *Piper longum* (Pipla) and *Zanthoxylum armatum* (Timur)-   * 1. Uses and sustainable harvesting technologies of some important MAPs : *Ophicordyceps sinensis* (Yarshagumba) *Nardostachys grandiflora* (Jatamashi), *Podophyllum hexandrum* (Laghu patra), *Glycyrrhiza grabra* (Jethi madhu)   2. Herbal cosmetics (some important herbs used for cosmetic uses : Aloe(*Aloe vera*), Neem(*Azadirachta indica*), Tulsi(*Ocimum sanctum*), Ashuro( *Adhatoda vasica*), Til (*Sesamum indica*),Besar or Turmeric( *Curcuma angustifolia*), Ritha ( *Sapindus mukorossi*), Badam ( Arachis hypogea), Amla( *Emblica officinalis*), Coconut oil( *Cocos nucifera*), Sunflower oil( *Helianthus annus*), Srikhand ( *Santalum album*), Garlic ( *Allium sativum)* |
| * Explain the meaning of organic farming. * Explain the importance and challenges of organic farming in Nepal. * List some important organic agricultural crops cultivated in Nepal. * Describe the vegetative structure and life cycle of a typical mushroom. * List some important edible and poisonous mushrooms found in Nepal. * Identify some precautions for consuming wild mushrooms. * To identify symptoms of mushroom poisoning and measures for domestic treatment. * List some important wild edible and cultivated mushrooms in Nepal. * Explain the nutritional and medicinal value of mushrooms. * Explain the general technique of mushroom farming. * Explain the steps of farming some mushrooms cultivated in Nepal: *Pleurotus* sp. (Kanye chyau or Oyster mushroom), *Agaricus bisporus* (Gobre chyau or Button mushroom), *Lentinula edodes* (Mrige or Shitake chyau), *Volvariella* sp. (Parale chyau or paddy straw mushroom). * Explain the present status of mushroom farming in Nepal in different Research centers, farming stations, mushroom industries, mushroom development and promotion centres. | **Unit II. Organic Farming & Mushroom farming (15)**  2.1.**Organic Farming –** (2)  2.1.1. Introduction, Importance and challenges of organic farming in Nepal  2.1.2. Some important organic agricultural crops cultivated in Nepal (Vegetables: pea, soybean, Coriander, cauliflower, cabbage, lady finger, brinjal, radish, spinach, tomato, carrot, bitter gourd, etc. Other crops: mushroom, turmeric, garlic, ginger, cucumber, tea, chilly, fenugreek etc.).   * 1. **Mushroom farming–**  (13)      1. Vegetative structure and life cycle of a typical mushroom   2.2.2. Edible and poisonous mushrooms  2.2.2.1.Precautions for consuming wild mushrooms and symptoms after consuming poisonous mushrooms and domestic treatment   * + - 1. Edible mushrooms- wild and cultivated     1. Nutritional and medicinal value of mushrooms     2. Major types of cultivated mushrooms in Nepal: *Pleurotus* sp. (Kanye chyau or Oyster mushroom), *Agaricus bisporus* (Gobre chyau or Button mushroom), *Lentinula edodes* (Mrige or Shitake chyau), *Volvariella* sp. (Parale chyau or paddy straw mushroom), *Calocybe indica* (Dudhe chyau), *Coprinus commatus* (Katle chyau), *Ganoderma lucidum* (Ragate chyau)     3. Mushroom farming – Steps of mushroom farming – 1. Composting 2. Spawning 3. Casing 4. Pinning 5. Cropping     4. Present status of mushroom farming in Nepal Major Mushroom Research centres, farming stations, mushroom industries, mushroom development and promotion centres in Nepal |
| * Give the concept of seed science and seed technology. * Describe different seed testing procedures with respect to physical purity, moisture content, germination (3 STTC test, Blotter method, Rolled Paper Towel seed germination test). * Describe the principles and methods of safe seed storage. * Explain the causes and effects of seed deterioration and its control. * Explain the seed dormancy and its significance * Explain the factors causing the seed dormancy and artificial methods of breaking the seed dormancy. | **Unit III. Seed Science (12)**   * 1. Introduction to Seed Science and Seed technology   2. Seed Testing Procedure – Method of testing – Physical purity, moisture content, (oven method), Germination 3 STTC test, Blotter method , rolled paper towel seed germination test (4)   3. Seed storage : principles and methods of safe seed storage, deterioration in storage and its control (4)   4. Physiology of seed: Dormancy and its significance , factors causing the seed dormancy and artificial methods of breaking the seed dormancy (3) |
| * List some important seed borne fungi found in cereals such as maize and wheat. * To explain the effects of seed borne fungi. * To explain the measures to control seed borne fungi. * Explain the provision of seed certificate and seed regulation in Nepal. | **Unit IV. Seed Pathology (8)**   * 1. Seed borne fungi      1. Effects and control of seed borne fungi   2. Seed certificate, seed regulation in Nepal |
| * Explain the different phases of cell cycle. * Explain the significance of mitosis and meiosis. * Explain different types of plant tissues( Permanent and meristematic tissues * Explain different types of permanent tissues(Simple and complex tissues) * Explain the types (apical and lateral meristems) and their role in plant development. * Explain significance of the primary and secondary growth in plants. * Explain the mechanism of flowering. * Explain the organogenesis and pattern of differentiation of major plant organs (shoot, leaf, flower, fruit and seeds). * Explain the process of fruit ripening. | **Unit V. Developmental Biology of Plants (15)**   * 1. Plant Cell, tissue and organs      1. Plant Cell         1. Cell cycle         2. Cell division – Significance of mitosis and meiosis      2. Plant tissues- Types (Permanent and Meristematic tissues )   5.1.2.1. Permanent tissues – Simple and Complex   * + - 1. Meristems : types and role of meristems in primary and secondary growth in plants     1. Plant Organs        1. Development processes in different stages of the plant life cycle – flowering, organogenesis and pattern of differentiation of major plant organs (shoot, leaf, flower, fruit and seeds), fruit ripening |

***Note:*** *The figures in the parenthesis indicate the approximate teaching hours for the**respective units.*

**Part II : Practical**

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| **Specific Objectives** | **Content** |
| * To collect and prepare herbarium specimens of some available medicinal and aromatic plants. | **Medicinal and aromatic plants**   * Identification and preservation of some available medicinal and aromatic plants. |
| * To carry out the seed germination test by blotter method and rolled paper towel method. | **Seed Science**   * Blotter Method and Rolled Paper towel Seed germination tests. |
| * To prepare culture media of fungi. * To isolate and identify some important seed borne fungi of cereals. | **Seed Pathology**   * Preparation of Culture media for fungi (PDA medium) * Seed borne fungi of cereals |
| * To collect, preserve and identify some available mushrooms. * To study vegetative and reproductive structures of a typical mushroom (*Agaricus*). * To study techniques of mushroom farming. | **Mushrooms**   * Identification and Preservation of some available mushrooms. * Structure and reproduction of a mushroom(*Agaricus*) * Techniques of mushroom farming |
| * To determine the mitotic index in a root tip from a permanent slide. * To study meristematic tissue of root tip from permanent slides. * To identify the different types of permanent tissues in plant from permanent slides. | **Developmental Biology of Plants**   * Determination of mitotic index * Plant tissues (Meristematic and Permanent). * Meristematic tissue of root tip. * Permanent tissues (Simple and Complex) |
| * To visit fields and agricultural laboratories for studying medicinal and aromatic plants, seed health testing, storage technique and mushroom farming and to submit the report. | **Field Trip**   * Visit to agricultural farms and laboratories * Submission of field trip report |

**Instructional Techniques**

The instructional techniques for this course are divided into two parts. First part deals with general instructional techniques applicable to most of the units. The second part pinpoints the specific instructional techniques applicable to particular unit/s.

**4.1 General Instructional Techniques**

* Lecture method
* Discussion method
* Demonstration method
* Problem solving method
* Collaborative method
* Experimental method
  1. **Specific Instructional Techniques**

Project method with report writing in Unit I, II and III.

1. **Evaluation**

Students are required to secure pass marks independently both in Theory and Practical.

**Part I : Theory**

Annual examination will be held by the Office of the Controller of Examinations at the end of the academic session for which 40 percent of total marks will be allocated. The number and types of questions are given below:

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| --- | --- | --- | --- |
| **Types of questions** | **Total questions**  **to be asked** | **Number of questions**  **to be answered and marks allocated** | **Total marks** |
| Group A: Multiple choice items | 7questions | 7x 1 mark | 7 |
| Group B: Short answer questions | 3 with 1 or questions | 3 x 7 | 21 |
| Group C: Long answer questions | 1 with 1 or question | 1 x 12 marks | 12 |
|  |  | Total | 40 Marks |

**Part II : Practical Part**

The marks allocated to practical part are given in the following table.

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| **Practical Examination** | **Area of Examination** | **Marks** | **Total** |
| Internal | Regularity | 1 | 2 |
| Record book | 1 |
| External | Major Experiment | 2 | 8 |
| Minor Experiment | 2 |
| Project work and collection of teaching materials | 2 |
| Viva | 2 |

**Recommended and Reference Books for Theoretical part**

**Unit I**

DPR (2016). *Medicinal Plants of Nepal.* Department of Plant Resources. Ministry of Forests and Soil Conservation. Government of Nepal, Kathmandu

DPR (2067 BS). *Nepalko Aarthik Bikaskalagi Prathamikta Prapta 30 Jadibutiharuko Pahichan Pustika.* Department of Plant Resources, Ministry of Forests and Soil Conservation. Government of Nepal, Kathmandu.

Farooqi A. A. and Sreeramu B. S. (2010). *Cultivation of Medicinal and Aromatic Crops.* Universities Press ( India) Private Limited, Hyderabad, India.

Jha P.K. , Karmacharya S. B. , Chettri M.K. , Banis C. B. and Shrestha B. B. eds 2008. *Medicinal Plants in Nepal: An Anthology of Contemporary Research. Ecological Society ( ECOS)*, Kathmandu.

Thomas Y., Karki, M., and Parajuli D. eds (2002). *Himalayan Medicinal and Aromatic Plants. Balancing Use and Conservation.* Proceedings of the Regional Workshop on Wise Practices and Experimental Learning in Conservation and Management of Himalaya Medicinal Plants (December 15-20, 2002, Kathmandu, Nepal. Ministry of Forests and Soil Conservation. HMG of Nepal, Kathmandu.

**Unit II**

Biswas, Subrata, Datta, M. and Nagachan, S.V. (2012). *Mushrooms : A Manual for Cultivation.* PHI Learning Private Limited , New Delhi, India.

Suman and Sharma (2007). *Mushroom Cultivation and uses*. AGROBIOS, India.~~.~~

Jana, B. L. (2015). *Relevance of Organic Farming*. Aavashkar Publishers Distributers, Jaipur, India.

Neupane, S.P. (2014). *Mushroom Farming in Nepal* (in Nepali). Kathmandu, Binita Neupane , Kathmandu.

Ram, R.C. (2007). *Mushrooms and their cultivation techniques.* Aviskar Prakashan. Jaipur, India.

**Unit III**

Kumar, Ashok (2014). *Seed technology & Pathology*. Discovery Publishing House Pvt. Ltd. New Delhi.

Padmavathi, S (2012). *A textbook of Seed Sciene and Technology.* New India Publishing Agency(NIPA), New Delhi.

Noggle G.R. and Fritz, G.J. . *Introductory Plant Physiology.* Prentice Hall if India. Pvt. , New Delhi, India.

**Unit IV**

Pandey B. P. (1992). *Plant Pathology. Pathogen and Plant Diseases .* S. Chand and Company Limited .

**For Unit V**

Pandey, S. N. and .Chadha, A.(2008). *Plant Anatomy and Embryology*.Vikash Publishing House Pvt. Ltd. , New Delhi.

Pandey, S. N. and Sinha, B.K. (2006). *Plant Physiology*. Bikash Publishing House Pvt. Ltd., New Delhi.

Piyush, R. (2006). *Plant Anatomy.* New Central Book Agency (P) Ltd., Kalkata, India.

Shukla, R. S. and Chandel, P.S.( 2007). *Cytogenetics, Evolution, Biostatistics and Plant Breeding*. S. Chand & Company Ltd

Soper, R. (2005). *Biological Science*. Cambridge University Press, UK.

Twymar, R. M. (2001). *Developmental Biology*. Viva BookPvt. Ltd., New Delhi.

**Recommended books for Practical part**

Aneja, K. R. (2003). *Experiments in Microbiology, Plant Pathology and Biotechnology*.

New Age International Publishers, New Delhi, India.

Pandey, B. P.(2005). *Modern Practical Botany*, Vol I & Vol. II. S. Chand & Company

Ltd., New Delhi.

Santra, S. S., Chatterjee, T.P. and Das, A.P. (1990). *College Botany Practical*. Vol. I.

New Central Book Agenct (P) Ltd., Calcutta, India.

Sharma, Reema (2014). *Laboratory Manual on Seed Pathology*. Anmol

Publications, New Delhi.